WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Seminar Notes For

TOTAL COST ASSESSMENT

April, 2000
Hazardous Waste and Toxics Reduction Program
Washington State Department of Ecology
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INTRODUCTION

This document contains class notes for a seminar on *Total Cost Assessment* (TCA), presented to HWTR Toxics Reduction (TR) staff at LOMA in April of 2000. This seminar provided 3 hours of training on cost accounting and financial analysis of pollution prevention options. The training was presented in conjunction with training on *Process Mapping and Mass Balances,* since process maps and mass balances can provide a basis for TCA analysis.

The development of this training began with asking the question, “Where is TCA involved in our work and what do TR staff need to know about TCA in order to do their job?” To answer this question, the team drafted “Minimum Performance Expectations” for TR staff, based on the *Pollution Prevention Planning Guidance Manual* (Publication # 91-2), *Cost Assessment for Pollution Prevention* (Pub. #95-400) and work frequently performed in the field by staff. After review and comment by TR staff, the Minimum Performance Expectations were adopted by the TR Network.

The team then developed an assessment test to gage staff skill levels in the minimum performance expectations. The results of the test were used to design the curriculum for this training. A post-test given after the training will be compared with previous test scores in order to gage the outcomes and effectiveness of this training.

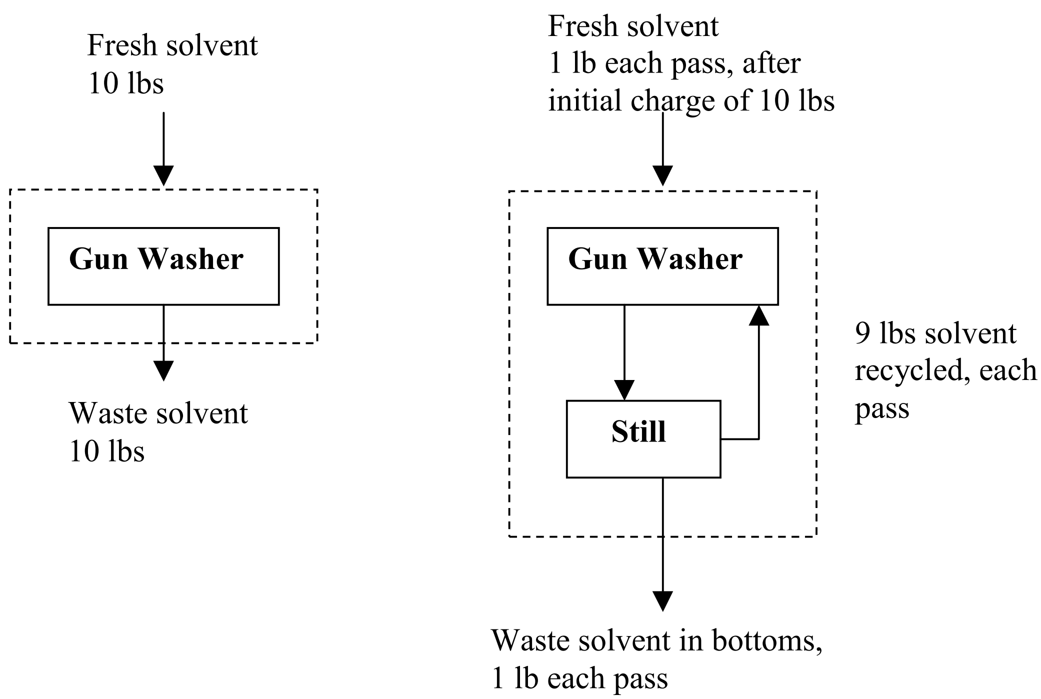
The first test indicated that staff would be coming to this training with widely varying levels of expertise. The purpose of this training was to assure that all TR staff share a common base of knowledge about TCA, so that this can be used as a starting point for future training in TCA topics.

Staff involved in the development and delivery of this training included Dennis Murray, Linda Pang, Judy Kennedy, Rob Reuter, and John Blunt.

RELATIONSHIP OF TCA TO PROCESS MAPPING AND MASS BALANCES

Process diagrams and mass balances provide data on material flows--data that help to identify costs related to a process and changes to that process. For example, consider the "before" and "after" diagrams (Figure 1.) for the installation of a solvent still to recycle paint gun cleaner:

Figure 1. Before and After Diagrams for Installation of a Solvent Still



These process diagrams and mass balances indicate that initially 10 lbs of waste solvent was produced for every 10 lbs of fresh solvent used (disregarding emissions and other minor losses). After the installation of a still, each 10 lbs of solvent passing through the system produces only 1 lb of waste, one-tenth of the waste previously generated. It can be assumed that waste shipment costs are reduced by a factor of 10, as are solvent purchase costs. The added cost per pound of operating the still would equal the cost per distillation batch, divided by the pounds processed per batch.

Similarly, combining mass balances and TCA can provide information on the "true" (including hidden) costs of a gallon of water, a gallon of metal working fluid, or a batch of resin. As more types of environmental and materials handling costs are included in the analysis, these "cost per unit" metrics begin to provide a valuable summary of the true costs involved.

THE "TOTAL" IN "TCA":
The Difference A Good TCA Analysis Can Make

Pollution prevention can save money on the costs involved in an industrial production process. Unfortunately, the costs involved in handling hazardous substances are frequently not identified, or are buried in a general category labeled as "overhead" or "administrative costs". Incomplete cost analyses can lead to gross inaccuracies that may cause unnecessary rejection of a P2 opportunity.

Table 1. shows statistics on costs frequently assigned to general "overhead", from an EPA study of industry accounting practices. These are frequently the very costs that are reduced through pollution prevention. If these costs are not identified, assigned to a specific process, and included in an economic analysis, the resulting inaccuracies tend to undervalue pollution prevention alternatives.

Table 1. Assignment of Costs

Cost	**Always to Overhead** % Respondents	**Usually to Overhead** % Respondents
Legal staff labor time	74	23
Environmental staff labor time	68	26
Environmental penalties	67	24
Reporting to government agencies	65	28
Staff training for environmental compliance	64	27
Insurance costs	64	26
Permitting	60	29
Environmental testing and monitoring	58	23
Manifesting hazardous waste	58	29
Transporting hazardous waste off-site	58	28
On-site wastewater treatment	57	22
Air emission controls	56	24
Hazardous waste handling	56	22

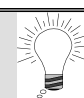
The magnitude of these inaccuracies can be surprisingly large. At Amoco's Yorktown refinery, the EPA study found environmental costs to be 22% of total operating costs. Refinery managers had previously estimated that environmental costs were 3% to 4% of operating costs! **Table 2**, showing other examples from the EPA study, illustrates the inaccuracies that can result from common accounting practices that fail to include key environmental costs. These examples reveal common accounting practices leading to errors of 14%, 35%, and 159 %:

Table 2. Examples of Accounting Inaccuracies

White Water & Fiber Reuse Project			
	Company Analysis	**TCA**	**TCA Difference**
Total Capital Costs	$ 1,469	$ 1,469	
Annual Savings	$ 351	$ 911	
Payback	4.18 yrs	1.61 yrs	159 %
Paint/Water Separator Project			
	Company Analysis	**TCA**	**Difference**
Total Capital Costs	$ 19,659	$ 19,733	
Annual Savings	$ 4,583	$ 5,234	
Payback	4.29 yrs	3.77 yrs	14 %
Paper Coating Conversion Project			
	Company Analysis	**TCA**	**Difference**
Total Capital Costs	$ 893,449	$ 923,449	
Annual Savings	$ 126,112	$ 87,167	
Payback	7.6 yrs	11.7 yrs	- 35 %

Identifying Costs
A complete inventory is the single most important component of a Total Cost Assessment. The cost inventory must include all costs necessary to determine if the project investment is profitable. The comprehensive cost information obtained through TCA gives a more accurate picture of the true costs and savings generated by pollution prevention projects. This "levels the playing field" so pollution prevention projects can compete for scarce investment funds during the capital budgeting process.

Table 3. Lists costs commonly involved in industrial processes and pollution prevention options. Table 3. shows usually-considered (production related) costs, compliance costs, and oversight costs.



Washington's Pollution Prevention Planning Act and WAC 173-307 require that an economic feasibility analysis for pollution prevention planning include not only usual costs, but also compliance and oversight costs (Worksheets D and H of the planning guidance manual). Examples of these costs are shown in Table 3.

Table 3. Typical Costs Commonly Involved in Industrial Processes

Typical Costs and Activities to consider in Pollution Prevention Economic Analysis

Usual Costs	Compliance Costs	Oversight Costs
Depreciable Capital Costs	**Receiving Area**	**Purchasing**
Engineering ______ ______	Spill response equipment ______ ______	*Product/vendor Research* ______ ______
Procurement ______ ______	Emergency response plan ______ ______	Regulatory impact analysis ______ ______
Equipment ______ ______	**Raw Materials Storage**	*Inventory control* ______ ______
Materials ______ ______	*Storage facilities* ______ ______	**Engineering**
Utility Connections ______ ______	Secondary containment ______ ______	Hazard analysis ______ ______
Site preparation ______ ______	Right-to-know training ______ ______	*Sampling and testing* ______ ______
Facilities ______ ______	Reporting and records ______ ______	**Production**
Installation ______ ______	*Safety training* ______ ______	*Employee training* ______ ______
Operating Expenses	Container labels ______ ______	Emergency planning ______ ______
Start-up ______ ______	**Process Area**	Medical monitoring ______ ______
Training ______ ______	Safety equipment ______ ______	*Re-work* ______ ______
Initial raw materials ______ ______	Right-to-know training ______ ______	Waste collection ______ ______
Raw materials ______ ______	Waste collection equipment ______ ______	*Disposal management* ______ ______
Supplies ______ ______	*Emission control equipment* ______ ______	Inspections and audits ______ ______
Direct labor ______ ______	*Sampling and Testing* ______ ______	**Marketing**
Utilities ______ ______	*Reporting and records* ______ ______	Public relations ______ ______
Maintenance ______ ______	**Solid and Hazardous Waste**	**Management**
Salvage value ______ ______	*Sampling and Testing* ______ ______	Regulatory research ______ ______
Operating Revenues	*Containers* ______ ______	*Legal fees* ______ ______
Revenues ______ ______	Labels and labeling ______ ______	Information systems ______ ______
By-product revenues ______ ______	Storage areas ______ ______	*Penalties and fines* ______ ______
	Transportation Fees ______ ______	Insurance ______ ______
	Disposal fees ______ ______	**Finance**
	Air and Water Emissions Control	*Credit costs* ______ ______
	Permit preparation ______ ______	Tied-up capital ______ ______
	Permit fees ______ ______	
	Capital costs ______ ______	
	Operating expenses ______ ______	
	Recovered materials ______ ______	
	Inspection and monitoring ______ ______	
	Recording and reporting ______ ______	
	Sampling and testing ______ ______	
	Emergency planning ______ ______	
	Discharge fees ______ ______	

Note:
Italicized costs are especially important to include in an economic analysis

It is also necessary to consider the costs of potential **liabilities** such as fines, employee exposures, environmental cleanup, etc. **Intangible** costs and benefits such as public image, employee morale, and increased sales should also be considered, since they may have a significant impact in some cases. While liability and intangible costs/benefits may be difficult to quantify, qualitative ratings of *high, medium, or low* should be assigned to such cost factors. Appendix III of the planning guidance manual provides a form for rating liability factors in this manner.

For the purposes of planning Worksheet D, an adequate accounting system is one that is able to provide the information necessary for the facility to do a TCA analysis and that includes the costs of oversight, compliance and liability.

Developing the Cost Inventory

1. Pursue the easiest cost categories first. The order of increasing difficulty generally is:
   - usual (production) costs
   - compliance and oversight costs
   - potential liabilities
   - intangible costs

2. Identify and analyze the largest costs first. These will vary by industry type. Look especially for expensive raw materials, such as organic coatings, and highly toxic wastes.

3. As you start with the most significant and most easily obtainable costs first, use a quick method such as simple payback to compare current and alternative processes. If you are not convinced that a pollution prevention option is sufficiently economical, continue to add more costs into the analysis. If necessary, use more sophisticated financial analysis methods such as Net Present Value. (The Financial Analysis section of this document provides instructions for performing simple payback and Net Present Value analyses.)

Appendix 3 of the planning guidance manual provides a method for analyzing the relative risks and costs of liability factors.

How extensive must a cost inventory be? The facility decides what is appropriate, but the inventory should be sufficient to avoid prematurely eliminating a pollution prevention option from consideration. Ecology staff should ask to be shown a cost analysis when a project is rejected for economic reasons.

Activity-Based Cost Accounting

Accounting systems that do not adequately address environmental costs often "lump" these costs into accounts for "general overhead" expenses. Additionally, it may be difficult to identify the individual processes that generated them. Costs should be allocated to processes, products, or projects on the basis of activities with a direct relationship to cost generation.

For example, disposal fees for paint wastes may be assigned to general overhead. Once identified, paint disposal costs could be divided among various product lines to see which generate the most paint waste expense. This might be done on the basis of widgets painted in each product line, total production hours per product line, or some other measure. The various product lines could then be compared on the basis of pounds of waste per widget, waste generated per hour, etc.

Activity-based cost accounting (ABC) can be used to generate some interesting metrics, such as:
- The cost of a gallon of water, when water supply and purification, wastewater treatment, and other water related costs are considered.
- The cost of a gallon of paint, when hazardous materials, safety, disposal, inventory, and training costs are included with the usual purchase costs.
- The cost per square foot of floor space in a plating operation, when various tank configurations are compared.

Such metrics can aid pollution prevention project decisions and management of valuable resources.

COMPARING COSTS: FINANCIAL ANALYSIS

After costs have been inventoried, financial analysis techniques can be used to compare the costs and overall profitability of different process alternatives. HWTR's P2 planning guidance allows businesses to use any suitable financial analysis technique. The two most common techniques are **Simple Payback** and **Net Present Value**. Both tools are acceptable to use for the purposes of pollution prevention planning.

Simple payback can be a quick method for comparing alternatives. Net present value (NPV) requires more financial skill, but offers the advantage of accounting for the time-value of money. To save time during a financial analysis, it might be possible to use simple payback for preliminary comparisons, and then use NPV for more accurate analysis.

For the purposes of pollution prevention planning, a financial analysis should be done to evaluate the economic feasibility of P2 options when economic considerations may be the reason for rejecting a P2 opportunity.

Cash Flow Diagrams

Cash flow diagrams provide a graphic illustration of a project's cash flow for both simple payback and NPV. Such diagrams are used to display each component of savings and costs, or the net savings and costs that occur each year (or other time period of choice). Time periods are marked on a horizontal line, as shown in **Figure 2**. Then cash flows are added, using upward arrows to represent an income or savings in a time period, and downward arrows for an expense or cost. Net cash flows are shown in **Figure 3**.

Figure 2. Time Periods

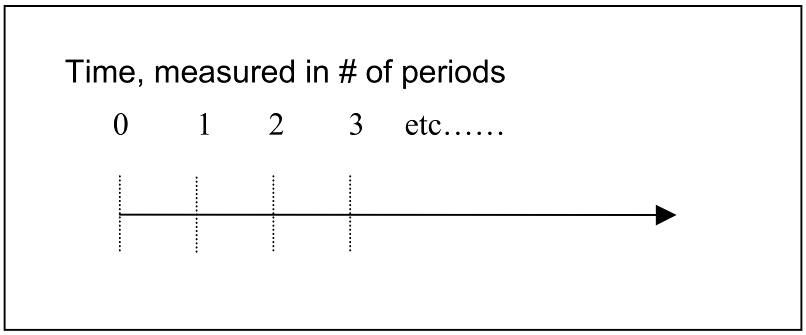
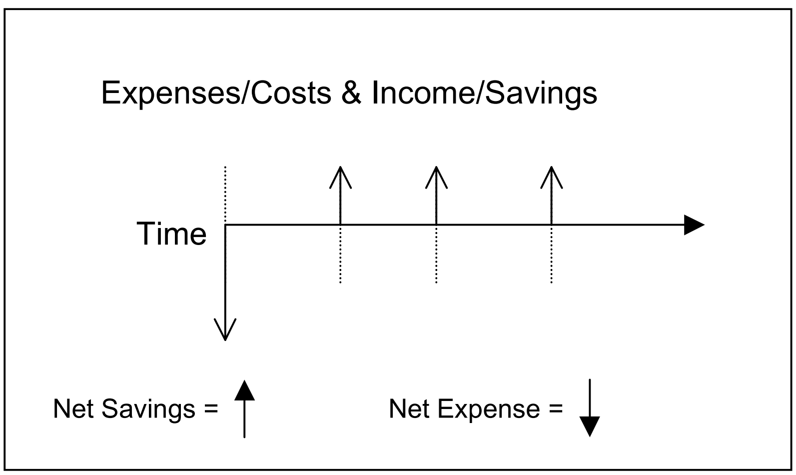
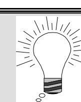


Figure 3. Cash Flow Diagram



Performing Simple Payback Analysis

Simple Payback considers the initial investment costs and the resulting annual cash flow. The payback period is the number of time periods (usually measured in years) to recover the initial investment in an opportunity.



Simple Payback measures only the time it takes to recover the initial investment cost.

$$\textbf{Simple Payback (in years)} = \frac{\text{Initial Investment Cost}}{\text{Annual Cash Flow}}$$

Consider the following example of a shop wishing to determine the profitability of purchasing a still to recycle its waste solvent **(Table 4).** The shop manager calculates the initial and annual costs, and determines that use of a still will result in a net annual savings:

Table 4. Installation of a Solvent Still

Initial Investment Cost	
Distillation Unit	$6,000
Installation	1,700
Total Investment Cost	**$7,700**
Annual Savings	
Raw Solvent Savings	$4,752
Current Disposal (24 drums)	4,800
Disposal After Installation (3 drums)	(1,050)
Total Annual Savings	**$8,502**
Annual Costs	
Operation	$3,640
Utilities	228
Total Annual Costs	**(3868)**
Net Annual Savings	**$4,634**

When the net annual savings is divided into the initial cost, the manager finds that the still will pay for itself in 1.7 years:

$$\textbf{Payback Period} = \frac{\$7700 \text{ Investment Costs}}{\$4634 \text{ Annual Savings}} = \textbf{1.7 years}$$

A tabular format can also be used to analyze payback. For example, if the initial investment is $10,000 and the annual cash savings is $4,000 then the payback period is $10,000 / $4,000 per year = 2.5 years. **Table 5** presents this example in table form.

Table 5. Equal Annual Payback Example

Year	Annual Cash Flow at End of the Year	Cumulative Cash Balance at End of the Year
0	($10,000)	($10,000)
1	$ 4,000	($6,000)
2	$4,000	($2,000)
2.5 = Payback	$2,000	$0
3	$4,000	$2,000

*Simple Payback Analysis - with **Unequal** Annual Cash Flows*

If the annual cash flows vary, again the payback period is when the cash savings equal the initial investment. For example, consider an initial investment is $10,000 that generates projected savings of $4,000 for the first year, $3,000 for the second year, $2,000 for the third year, and $2,000 for the fourth year. Payback is achieved when the initial cash investment equals the cash savings, e.g. when the cumulative cash flow balance equals zero. The payback would be at 3.5 years. **Table 6** illustrates this procedure.

Table 6. Unequal Annual Payback Example

Year	Annual Cash Flow at End of the Year	Cumulative Cash Balance at End of the Year
0	($10,000)	($10,000)
1	$ 4,000	($6,000)
2	$3,000	($3,000)
3	$2,000	($1,000)
3.5 = Payback	$1,000	$0
4	$2,000	$1,000

Net Present Value (NPV) and the Time-Value of Money

NPV is another common method for performing an economic analysis, and is based on *the time-value of money*. This concept recognizes that money loses or gains value over time. Inflation causes it to lose value over time, so that a dollar won't be able to buy as much next year as it can buy today. However, if that dollar is invested at an interest rate that is greater than the inflation rate, that dollar will increase in value over time. A dollar today has a **present value**. Later in time, this dollar will have a different **future value**.

Thus a dollar today is worth more than a dollar tomorrow. To make financial comparisons easier, future cash flows can be translated to *today's* dollars.

The Future Value (FV) of money can be found by using the following formula:

$$FV = PV (1+i)^n$$

Where…

FV = future value of an amount
PV = present value of an amount
i = the interest rate at which the amount will increase or decrease in the future.
n = the number of periods into the future

When starting with the Future Value of money, the Present Value can be found with the following formula:

$$PV = FV/(1+i)^n$$

Where…

PV = Present Value of an amount
FV = Future Value of an amount
i = the interest rate at which the amount will increase or decrease in the future
n = the number of periods the amount will be discounted to the present

As seen in these formulas, the value of money depends on the value of ***i*** and the number of time periods (**n**) involved. **Tables 7** and **8** illustrate the difference that the interest rate ***(i)*** and length of time (***n*** periods) can make:

Table7. How Future Value Varies with Number of Periods

Present Value	Rate	# Periods	Future Value		Present Value	Rate	# Periods	Future Value
PV	**i = 5%**	n	FV		PV	**i = 10%**	n	FV
$ 100	0.05	1	$105.00		$ 100	0.10	1	$110.00
$ 100	0.05	2	$110.25		$ 100	0.10	2	$121.00
$ 100	0.05	5	$127.63		$ 100	0.10	5	$161.05
$ 100	0.05	10	$162.89		$ 100	0.10	10	$259.37
(Note that the future value of the initial amount grows non-linearly with time. E.g., $100 growing at 5% over ten years is $162.89 not just $150. This is the effect of compounding.)								

Table 8. How Future Value Varies With Interest Rate, i.

Present Value	Rate	# Periods	Future Value
PV	I	**n = 10 years**	FV
$ 100	0.01	10	$110.46
$ 100	0.02	10	$121.90
$ 100	0.05	10	$162.89
$ 100	0.10	10	$259.37
(Note that the higher the interest rate, the faster the growth in future values. E.g. $100 growing at 10% for 10 years is a $159.37 increase over $100, not just $104.60.)			

The facility will determine an appropriate vale of ***i*** to use in their financial analysis. This number is a function of the cost of capital for that business and what amount of return they require from an investment in a project. Currently (year 2000), this number is about 15–20%.

The easiest way to account for the time value of money is to calculate Net Present Value using the form provided in Table 13, or by using P2 Finance software. Both methods are covered in the following sections.

Besides using the formulas given above, present value (PV) and future value (FV) can be determined by using the following tools available to HWTR staff:

- Business calculators with built-in functions for determining FV and PV
- Tables showing factors that can be used to determine the FV and PV for different values of ***i*** and ***n***. These can be obtained from economics textbooks or lending institutions.
- Computer spreadsheets with formulas or built-in functions, such as Excel.

Financial Analysis Using Net Present Value (NPV)
A financial analysis using the Net Present Value method sums the present values (PV) of future cash flows to derive a single number (NPV) that reflects the profitability of a project. When NPV is greater than 0, the project is profitable for the business to implement. The greater the NPV value, the more profitable the project. As with the simple payback method, businesses can use NPV method to make decisions about whether or not to implement P2 opportunities, and to rank several projects that are competing for a business' capital.

The following method can be used to determine the NPV of a project over time:

Step 1. Determine the relevant costs and savings that would be impacted by the project.

Step 2. Determine the timing of these costs and savings. Consider the relevant life of the project. This is the period of time that the project will have financial impact on the business. You now have a cash flow for the project, as illustrated in **Figure 4**.

Step 3. Determine the appropriate interest rate ***i***.

Step 4. Calculate the present value for the net cash flow in each time period, as illustrated in **Figure 5**.

Step5. Determine the NPV for the project by summing the present values over the entire time period. Remember, if the net present value is a positive value it will contribute positively to the company. The greater the value of the NPV, the more profitable the cash flow.

Figure 4. Cash Flow Diagram for NPV

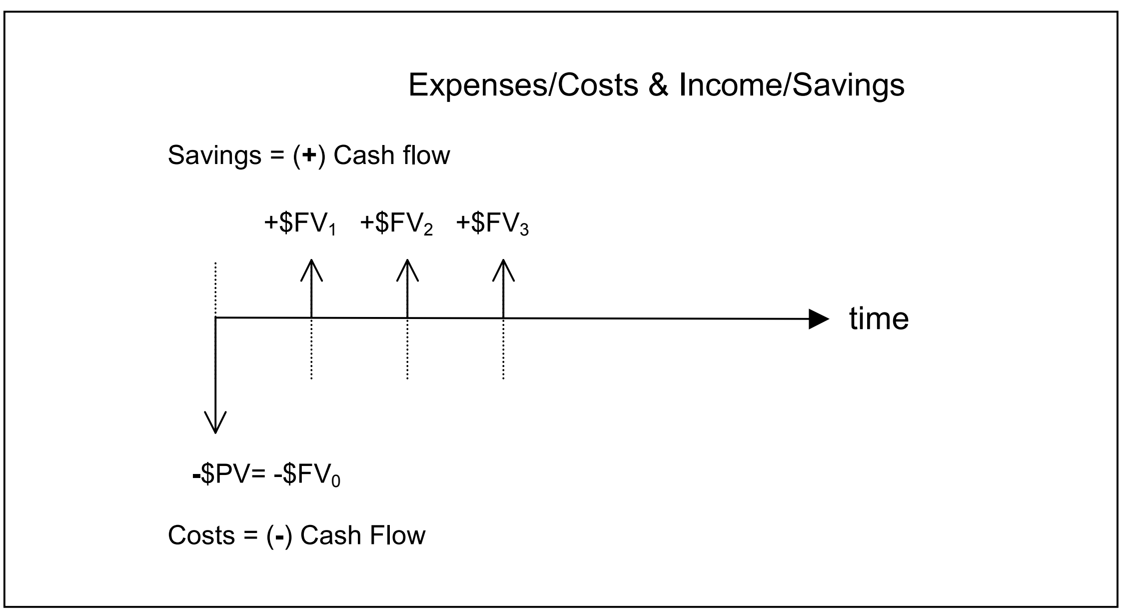
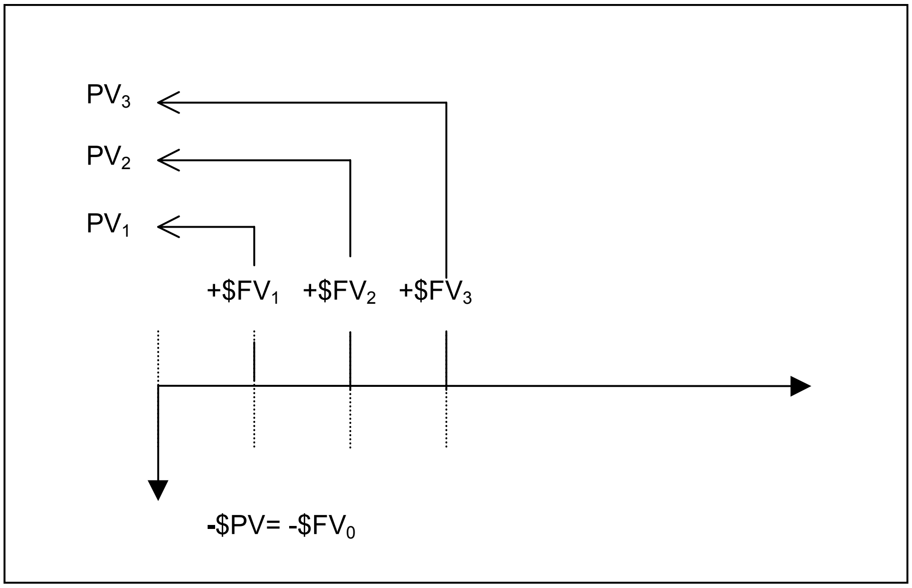


Figure 5. Present Value of Future Cash Flows



Comparing Simple Payback vs. Net Present Value

Simple Payback:
Simple payback should be used for small projects and avoided for long-term projects in which a significant portion of the costs or revenues could occur in the later years (after recovering the initial investment costs). Payback can also be used as a first-cut, rough screening analysis to determine the desirability of implementing a project.

An investment's payback does not necessarily reflect its overall profitability since payback only measures the time it takes to recover the initial investment cost. For pollution prevention projects, this can be an especially significant limitation because annual savings may occur several years after the initial investment cost is recovered. As a result, simple payback does not recognize the *long-term* benefits of pollution prevention investments.

For example, suppose a facility is considering two investments, A and B, and each requires an initial investment of $50,000. Investment A generates $25,000 in revenues for the next three years, while Investment B generates $20,000 annually in revenues for the next 20 years. Using payback principles, Investment A is more profitable than Investment B because the facility recovers the initial investment cost earlier with Investment A. However, Investment A generates revenues for only three years, while Investment B continues to earn revenues for 20 years.

Net Present Value:
Net Present Value (NPV) is a profitability indicator that has few limitations and can be used in all types of analyses. It easily accommodates the use of an expanded cost inventory when calculating all costs and benefits. It is very useful since it is a direct measure of the project's profitability in dollars and therefore most directly relates to the facility's interest in higher cash

flows. Net Present Value considers the time-value of money, and therefore recognizes that the timing of cash flows is relevant to the profitability of a pollution prevention project.

NPV can consider cash flows and profitability of a project over a sufficiently long time horizon to capture the benefits of pollution prevention investments. It is particularly important to use with long-term capital investments with many costs and potential salvage value.

Table 9. Profitability Indicators: Advantages & Disadvantages

	Major Advantages	Major Disadvantages
Simple Payback	Easy to Use	Neglects Time-Value of Money
Net Present Value	Considers Time-Value of Money Includes Later Costs and Savings	Need Facility's Cost of Capital

TAX CONSIDERATIONS IN A FINANCIAL ANALYSIS

Tax considerations affect the cost inventory for a project, and must be dealt with before conducting a comparative financial analysis. The following section describes ways in which taxes impact the cost inventory.

The form in Table 13 and P2 Finance software provide automatic calculation of tax considerations. These tools are described in later sections.

Depreciation

A facility's operating equipment loses value as it ages. This loss in value can occur for a number of reasons, including physical deterioration, technological antiquity, etc. Depreciation is the gradual tax deduction of the equipment costs over its lifetime. The Internal Revenue Service allows a facility to shield some of its taxable income through depreciation of the initial investment costs of a project. One potentially significant way to reduce taxable income is to deduct equipment depreciation costs from the project's annual cash inflow, as shown in **Table 10**.

Table 10. Taxable Income

Cash Inflow (revenues, salvage value)
-- Cash Outflow (operating costs)
-- Tax Depreciation
Taxable Income

Table 11 shows the typical depreciation periods for various types of property.

Table 11. Common Depreciation Periods

Type of Property	Depreciation Period
Small tools	3 years
Automobiles, office machinery, computers, and property used for research & development	5 years
Office equipment and most manufacturing equipment	7 years
Machinery and equipment used for petroleum distilling and refining, and for milling grain	10 years
Sewage treatment plants, telephone and electrical distribution facilities, and land improvements	15 years
Service stations and other property with a useful life less than 27.5 years	20 years
Residential rental property	27.5 years
Buildings and real estate in service before 5/13/93	31.5 years
Buildings and real estate in service after 5/13/93	39 year

Salvage Value

Salvage value is the potential resale value of equipment at the end of its useful lifetime. This resale value has a revenue-generating potential and could be taxable.

Tax Credits

There is no state **sales tax** on process manufacturing equipment purchased by a facility, or a facility's product storage buildings.

In addition, Section 179 of the Internal Revenue Code allows a facility to **deduct all or part of the cost of certain qualifying property** in the year a facility places it into service. A facility is allowed to do this instead of recovering the cost by taking depreciation deductions over a specified depreciation period. The maximum Section 179 deduction for the year 2000 is $20,000. A facility may have the ability to claim an increased Section 179 deduction if it qualifies as an "enterprise zone business". This increase can be as much as an additional $20,000. Section 179 deduction details can be found at w*ww.irs.gov/prod/forms_pubs/pubs/p95403.htm*.

Capital Investments vs. Leasing

At any given time, a facility usually has multiple opportunities for investing it's capital. It may invest capital into projects such as end-of-pipe controls, and non-environmental investments like remodeling or plant expansion. The initial investment cost makes pollution prevention projects a challenge and as we have seen, can have significant tax drawbacks. To avoid this initial investment cost, a facility may decide to lease equipment for a project. The leased equipment must be free-standing and not an integral part of other machinery.

Leasing generally offers the following benefits:

1) protects working capital by providing 100% financing
2) preserves the facility's line of credit (lease agreements are generally not regarded as debt liability)
3) is tax deductible when payments are considered operating expenses
4) offers 12-60 month payment agreements
5) the leasing company often maintains/updates the equipment

Including Taxes in the Cost Inventory

Costs and savings need to reflect tax implications when making an investment decision. If a project saves $4,000 a year in lower energy costs and $16,000 a year from improved operation and maintenance, a facility's taxable income increases by $20,000, as shown in **Table 12**. The result is that the facility pays more taxes. Taxes also affect costs by way of depreciation. Although depreciation is a non-cash charge, it is treated as an expense that lowers taxable income. Consequently, depreciation must be subtracted from incremental profits to arrive at the taxable income, and then be added back to profits, after tax, to reflect actual cash flow, as shown in Table 12.

Table 12. After -Tax Annual Cash Flow

Energy Savings	$4,000
O & M Savings (incl. salvage)	+ 16,000
Total Pre-Tax Savings	20,000
Less Depreciation	- 5,000
Profit Before Tax	15,000
Less Tax @ 50%	- 7,500
Profits After Tax	7,500
Plus Depreciation	+ 5,000
After-Tax Annual Cash Flow	**$12,500**

Thus, the net savings for this project changed from $20,000 to $12,500 when depreciation and taxes were accounted for.

USING FORMS PROVIDED IN ECOLOGY PUBLICATION # 95-400

The recently revised Ecology publication, *Cost Analysis for Pollution Prevention* (# 95-400), includes a form (shown in **Table 13**, below) that can be used to calculate both payback and NPV. It is accompanied by a table of Present Value factors (shown in **Table 14**) for use with this form. The form includes tax considerations. Line-by-line instructions for using this form are available on its reverse side in publication #95-400.

TABLE 13. Financial Analysis Form

PROJECT NAME:

Line	Cash Flow (refer to Table 1)	Year 0 (today)	End of Year 1	End of Year 2	End of Year 3	End of Year 4	End of Year 5
1	Initial investment						
	Operating Cash Flow:						
2	Revenues						
3	Usual Costs						
4	Compliance Costs						
5	Oversight Costs						
6	Operating Income (subtract lines 3,4,5 from 2)						
7	Depreciation of equipment						
8	Total taxable income (subtract line7 from 6)						
9	Taxes						
10	Depreciation of equipment						
11	Annual cash flow (subtract line 9 from 8 and add line 10)	0.00					
12	Total cash flow (subtract line 1 from line 11)						
13	Present Value Factor (see Table 14)	1.0000					
14	Total Present Value Cash Flow (Multiply lines 12 and 13)						
15	Net Present Value (Sum annual values in line 14)		← Net Present Value for Project				

Table 14. Present Value Factors

Discount Rate	Year 1	Year 2	Year 3	Year 4	Year 5
5 percent	0.9524	0.9070	0.8638	0.8227	0.7835
10 percent	0.9091	0.8264	0.7513	0.6830	0.6209
15 percent	0.8696	0.7561	0.6575	0.5718	0.4972
20 percent	0.8333	0.6944	0.5787	0.4823	0.4019

Using the Financial Analysis Form for Payback
Lines 1 through 11 of Table 13 are used when evaluating the payback of a project. The payback period is calculated using the values in lines 1 and 11.

Using the Financial Analysis Form for NPV
Lines 1 through 15 are used to calculate NPV, using a present value factor selected from Table 14.

The following (**Table 15**) is an example of the use of the form in calculating the NPV of the project. Only selected lines from the form in Table 13 are shown:

Table 15. Calculation of NPV

Line	Cost Element	Year 0 (today)	End of Year 1	End of Year 2	End of Year 3	End of Year 4	End of Year 5
1	Initial investment	10,000	0	0	0	0	0
11	Annual cash flow (subtract line 9 from 8 and add line 10)	0.00	4,000	4,000	2,500	2,000	2000
12	Total cash flow (subtract line 1 from line 11)	(10,000)	4,000	4,000	2,500	2,000	2,000
13	Present Value Factor* (see Table 14)	1.0000	0.8696	0.7561	0.6575	0.5718	0.4972
14	Total Present Value Cash Flow (Multiply lines 12 and 13)	(10,000)	3,478	3,024	1,644	1,144	994
15	Net Present Value (Sum annual values in line 14) **Assume 15% Discount Rate*	$ 285					

USING TCA SOFTWARE

P2Finance
P2 Finance is an easy-to-use spreadsheet software for Total Cost Assessment, developed for EPA by the Tellus Institute. *P2 Finance* will automatically calculate NPV and payback, and includes tax considerations. It can be downloaded for free from EPA's website at http://www.epa.gov/opptintr/acctg/download/p2finan.htm It is also available on Ecology's common network drive at X:\P2finance.

When you download *P2 Finance* you will find files for the spreadsheet, a step-by-step user's guide, and a couple case study examples. *P2 Finance* allows you to input data on an extensive inventory of project costs, and then performs the financial analyses of your choice to compare project options you specify. Taxes are automatically calculated using data you supply.

CAGE
The Coating Alternatives Guide (CAGE) website has developed a web-based tool to calculate the costs of converting to a new coating process. The tool analyzes costs of materials, energy, equipment, labor, maintenance, and waste. It can be accessed at http://cagebeta.rti.org/economics/index.cfm.

TCA RESOURCES

Rob Reuter (NWRO) is the designated Toxics Reduction staff expert for Total Cost Assessment. He is available to answer your questions and assist you with TCA analyses.

As part of this training project, the TCA team has revised Ecology Publication # 95-400, ***Cost Analysis for Pollution Prevention*** and Appendix II in Ecology's ***Pollution Prevention Guidance Manual****,* Publication # 91-2. These publications now include improved instructions for cost accounting and financial analysis as well as examples.

There are also several helpful websites available, including**:**

- *An Introduction to Environmental Accounting As A Business Management Tool: Key concepts and Terms* (EPA, 1995) is found at http://www.p2pays.org/ref/02/01306.pdf

- Other resources from EPA's Environmental Accounting Project are found at http://www.epa.gov/opptintr/acctg/